Biological Imperatives: Women's Careers in the Biosciences

Athena Unbound: The Advancement of Women in Science and Technology
By Henry Etkowitz, Carol Kemelgor, and Brian Uzzi
Cambridge: Cambridge University Press (2000).
216 pp. $54.95

Despite the romantic title, *Athena Unbound* is a methodical look at women in science. As a reference book, it provides data and analysis that are usually interesting, occasionally mundane, and sporadically profound. The authors are to be applauded for helping to keep the unique challenges of women in science at the forefront of social consciousness. Ironically, advances by women scientists in recent decades, most notably their vastly increased presence in the early stages of education and career development, may produce a sense of false security, a temptation to look at all the women populating research labs across the country and ask, "so what's the problem?" Of course, there are still profound problems, and *Athena Unbound* brings out many of them, from the competitive nature of undergraduate science classes to the exploitation of postdocs, to more subtle social exclusions suffered by women in science. However, the authors seldom compare the career obstacles suffered by women scientists to those suffered by their male peers.

This is a loss, because the similarities and dissimilarities between men and women developing and expanding careers may be the most revealing aspect of the science workplace. For example, a 1998 study of its own membership by the American Society for Cell Biology (ASCB) (*The Career Structure in Biomedical Research: Implications for Training and Trainees,* Mol. Biol. Cell *9*, 3003–3006, 1998) found that while biological scientists perceive that grants are harder to win over time, that obtaining a preferred independent position has become more elusive, and that the number of years spent as a postdoctoral fellow has increased substantially, there are no significant differences reported in any of these important measures of career advancement between women and men. Similarly, the National Academy of Sciences 1998 COSEPUP report on *Trends in the Early Career of Life Scientists* (National Academy Press, http://www.nap.edu) documents that over the last generation, the life science Ph.D. takes two years longer to obtain, the median age for an academic life scientist to attain a tenure-track position has increased by eight years, and that 39% of those who had obtained their Ph.D.s 5-6 years earlier still did not have an independent job, versus 11% a generation earlier, but it reveals no gender difference in any of these parameters. *Athena Unbound* downplays the fact that in science it can be tough for everyone, presenting in most cases just the data that relate to women.

Nevertheless, the barriers that appear to be unique to or higher for women persist to a surprising extent. As Etkowitz et al. discuss, women face the unique conflict presented by the coincidence of child-bearing years with the period in which one's career typically is most demanding, postdoctoral training and/or early stages of independence. The authors fail, however, to explore beyond the obvious biological reality to put the dilemma in economic, personal, and social context. For example, COSEPUP's report reveals a significant salary differential between men and women postdocs (*Enhancing the Postdoctoral Experience for Scientists and Engineers*, National Academy Press). A study conducted by the ASCB and The National Bureau of Economic Research/Harvard (*Careers and Rewards in BioSciences: Extremophiles in the Ph.D. Job Market*, R. Freeman, E. Marincola, J. Rosenbaum, F. Solomon, E. Weinstein, in preparation) shows that according to the Bureau of Labor Statistics, women in the biological sciences without children work more hours than men in the biological sciences without children. But men, once they have children, work more hours than women and indeed more than they worked before they had children, though mothers in the biological sciences still work more hours than men or women in other sciences. One can infer from these data that productivity (as measured by hours worked) is significantly affected by children. The authors attribute the underlying barriers to the success of women scientists to "the structure of their social networks," but it should be acknowledged that the declining proportion of women moving up the seniority ranks in science may reflect at least in part the rational choice of some women, given the required time investment, uncertain outcome, and opportunity cost, to realign their career at this critical stage.

When one looks beyond diaper-avoidance, one appreciates how the dynamic of this shift affects the overall scientific workforce: a decision for two-scientist couples for one parent to opt out of the 60-hour-per-week pressure of running a lab may result in the increased motivation of the other parent to achieve professional success in order to provide financial and social stability for the family. Little-noticed data from the National Research Foundation (*Women, Minorities, and Persons With Disabilities in Science and Engineering*, National Science Foundation, September 2000) confirms an "ambition gap" between men and women: while 15% of women in the scientific workforce aspire to employment in a sector other than that in which they currently work (e.g., academia, industry, government), more than twice (33%) this proportion of men are working in a sector other than that which they prefer. People who have found rewarding science careers in teaching, writing, the media, government, etc., deserve respect and admiration rather than the marginalization they sometimes suffer.

The authors confirm that the seemingly intractable roadblock for women scientists appears to be at the senior level, e.g., as tenured professor, division leader, or branch chief (*Trends in the Early Careers of Life Scientists*, National Academy Press, 1998). Is this the result of death by a thousand cuts: countless, immeasurable insults, manipulations, and exclusions that in sum can drive women away from their original ambitions? Or is it a reflection of the eminent good judgment of those women who can dispassionately weigh the cost of a satisfying career at the bench and are willing to make the hard, sometimes stigmatizing choice of exploring other applications of their training in science? *Athena Unbound* would have the reader conclude the former.

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Computation and Biology: A Joint Venture

Computational Molecular Biology: An Algorithmic Approach
By Pavel Pevzner
Cambridge, MA: MIT Press (2000). 314 pp. $44.95

As we swim in a sea of data—both genomic and microarray—we need good computational tools to understand the biological significance of the information we generate. One such tool that has emerged from the field of computational molecular biology and is used widely by biologists is the sequence comparison tool BLAST. Other tools include multiple sequence alignment software such as ClustalX and contig assembly software such as Phrap. With the draft of the human genome sequence available now and the mouse genome sequence available shortly, we must increasingly turn to the field of computational molecular biology to build additional tools to help us make sense of these data.

As an undergraduate mathematics major at the University of Wisconsin in the 1970s, I was totally enthralled with population and quantitative genetics after taking an introductory genetics course from Professor James F. Crow. At the time, this area presented a way to apply my mathematical interest in the exciting field of genetics. Now, the potential areas of research for mathematicians and computer scientists interested in the field of molecular biology are equally rich and much more diverse.

The question does arise, however, how best to generate interest and train the next generation of computational biologists? There is a strong need to entice computer scientists into the field of computational biology to solve such problems as, for example, promoter recognition in genomic sequence, analytical tools for understanding data from microarray experiments, and accurate prediction of protein folds from sequences. Many universities and colleges are requiring all undergraduates to take an introductory course in biology. If you teach such a course, *Computational Molecular Biology* by Pevzner provides a useful high-level introduction to selected computational problems and solutions in molecular biology, which could be useful for those trained in computer science or mathematics who want to become familiar with the problems that interest biologists.

Conversely, there is also a need for biologists to understand the theory behind the tools that they use. When doing a BLAST search, a biologist should understand scoring matrices, probability distributions and alignment scores. The web-based forms for access to computational biology tools make it easy to just paste in some data and get back an answer never having to know what algorithm is used and how changes in parameters may affect the results. Unfortunately, *Computational Molecular Biology* will not help the lab biologist as it is not a cookbook for applied bioinformatics. Biologists are more likely to benefit from more application-oriented books such as Baxevanis and Ouellette, *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*, 1998. (Note: a second edition of this book is scheduled to be published in the spring of 2001.)

Computational Molecular Biology is based on a course that Pevzner has taught at the Pennsylvania State University and University of Southern California for a number of years to advanced undergraduate and graduate students in computer science and mathematics. Before reading this book, you would want to have some background in computational algorithms and combinatorial theory. If so, you will see familiar problems and algorithms such as backtracking, Hamiltonian path, and traveling salesman. A little background in molecular biology would also be helpful. There is a brief chapter titled “All You Need to Know about Molecular Biology,” but its first sentence is “Well, not really, of course, see Lewin, 1999 [*Genes VII*], for an introduction” (p. 271).

Each chapter in *Computational Molecular Biology* begins with an introduction to the computational and biological ideas without any formulas. For example, to introduce the computational problems associated with physical mapping, Pevzner describes the experiments used in the physical mapping of cystic fibrosis. To motivate the problem, he uses an analogy of having “... several copies of a book cut by scissors into thousands of pieces. Each copy is cut in an individual way such that a piece from one copy many overlap a piece from another copy.....” (p. 5). This is characteristic of the style of the book. For each computational problem, he gives an analogy that requires no biological knowledge and then describes the biological problem for which a computational solution is required. This is a good style and makes the introductory section of each chapter accessible to biologists interested in learning about some of the computational challenges in the field.

Pevzner covers problems drawn primarily from genomics and sequence analysis. Included are chapters on Computational Gene Hunting, Restriction Mapping, Map Assembly, Sequencing, Sequence Comparison, DNA Arrays, Multiple Alignment, Finding Signals in DNA, Gene Prediction, Genome Rearrangement, and Computational Proteomics. Readers interested in structural biology-related topics including such topics as predicting structure from sequence or other topics not covered by Pevzner will need to turn to other books. See for example *Bioinformatics: The Machine Learning Approach (Adaptive Computation and Machine Learning)* by Pierre Baldi and Soren Brunak, 1998; *Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology* by Dan Gusfield, 1997; or *Computational Methods in Molecular Biology* edited by Steven Salzberg, David Searls, and Simon Kasif, 1998.

Despite the limited breadth of Pevzner’s book, I believe *Computational Molecular Biology* will be, to a lim-